

The Stem Cell Debate: Embryonic Stem Cells Versus Adult Stem Cells

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Introduction

Stem cells are cells that can differentiate into more specialized cells. Of the two types of stem cells, embryonic stem cells and adult stem cells, embryonic stem cells are believed to be more pluripotent, meaning they are able to differentiate into more types of cells than adult stem cells. Due to this characteristic, embryonic stem cells are believed to have the potential to treat a number of diseases, including cancer and spinal cord injuries. Two main controversies lie in the acquisition of embryonic stem cells: the destruction of the blastocyst and the issue of therapeutic cloning.

When an egg and a sperm fuse, a zygote is formed that undergoes cleavages until the cell count reaches approximately 150 cells, at which point this early embryo is called a blastocyst (Bailey, 2001). To be used in research, embryonic stem cells must be extracted from the blastocyst, causing its destruction. The debate here is in whether it is acceptable to take the “life” of the embryo to potentially cure diseases and save future lives. Those who approve are then asked if this is acceptable to do only to excess blastocysts created in fertility clinics, destined to be destroyed anyways, or if it is acceptable to create new blastocysts for a purpose which will ultimately lead to their destruction.

In addition to in vitro fertilization, embryonic stem cells can be obtained through therapeutic cloning. Research is currently focused on the somatic cell nuclear transfer method, which produces embryonic stem cells that have the exact same genetic composition as the nuclear donor. Some believe that this type of cloning should be banned, citing moral reasons, and others believe that it is acceptable as long as the blastocyst is never implanted into a uterus and carried to term (reproductive cloning). Obtaining eggs from donors for this type of cloning

is also controversial because the extraction procedure is invasive and can cause a number of complications (Beeson, 2006).

The basis for the ethical dilemmas surrounding embryonic stem cells hinges upon the assumption that embryonic stem cells are “better” than the much less controversial and adult stem cells. and adult stem cells have been in the shadow of embryonic stem cells due to the numerous political debates and media reports centered on the embryonic stem cells issue. It may be easy for healthcare providers to favor embryonic stem cells research due to this publicity in conjunction with the concept of beneficence. The purpose of this paper is to educate healthcare providers on the often overlooked research behind adult stem cells vs. embryonic stem cells. Healthcare providers should be well informed of the science that can influence their political stance on stem cells due to the possible clinical ramifications of their political views.

Review of Literature

Embryonic stem cells have commonly been believed to be more pluripotent than adult stem cells. However, new research shows that adult stem cells are more like embryonic stem cells in terms of differentiation potential than previously thought. For example, Schultz and Lucas (2006) showed that adult muscle stem cells can change into nerve cells. Four sources of adult stem cells that have shown promise as alternatives to embryonic stem cells include olfactory cells, bone marrow cells, placental cells, and umbilical cord cells. A study by Murrell et al. (2005) demonstrated how adult olfactory cells can generate muscle, kidney, heart, liver, brain and nerve cells. In a study by Crain, Tran, and Mezey (2005), bone marrow stem cells from male donors were transplanted into females. The Y chromosomes of these cells were tagged so that they could be traced. The tagged Y chromosomes were found in various neurons in different parts of the brain, in both white and grey matter. Miki, Lehmann, Cai, Stolz, and

Strom (2005) showed that amniotic epithelial cells could generate cells of all three germ layers (endoderm, mesoderm, and ectoderm) just like embryonic stem cells. These cells also displayed low tumor tendency, a common problem in embryonic stem cells. In a study by Xiao, Nan, Motooka, and Low (2005), rats that had suffered ischemic strokes were injected with either non-hematopoietic umbilical cord blood stem cells (nh-UCBSCs) or saline (control). Those receiving nh-UCBSCs later performed significantly better on behavioral tests and showed a 50% reduction in lesion volume compared to the control. All of these four types of adult stem cells are easily accessible and do not require egg harvesting, cloning, or destruction of blastocysts.

There is some evidence to support the idea that adult stem cells are therapeutically more effective than embryonic stem cells. Prentice (2006) lists 72 diseases in which adult stem cells have shown benefits in human clinical trials, versus zero for embryonic stem cells. Three diseases in which adult stem cells research will be compared to embryonic stem cells research are: spinal cord injuries, diabetes, and Parkinson's disease.

In a recent pilot clinical study (Lima et al., 2006), seven patients with traumatic spinal cord injuries were given olfactory mucosa autografts containing adult stem cells onto the area of their lesions. MRIs showed that the lesions were moderately to completely filled in all seven patients. All seven patients had improvements on both motor and sensory test scores. Two regained bladder sensation, one of which also regained voluntary anal sphincter control. Deshpande et al., (2006) performed a similar embryonic stem cell study on rats paralyzed by spinal cord injuries. The rats regained partial mobility, but the success of the transplanted embryonic stem cell-derived axons relied heavily on the presence of a growth factor produced by adult neural stem cells.

To study the potential use of adult stem cells in diabetes, Yoshida et al. (2005) transplanted human umbilical cord blood stem cells into insulin-dependent diabetic mice. The result was that these adult stem cells generated insulin producing cells in the pancreatic tissue of the mice, reversing their condition. Recent diabetes studies using embryonic stem cells have not been as successful. Insulin-like cell clusters, embryonic stem cells that resemble islet-cells, were found to not have the ability to produce insulin—they could only regurgitate exogenously added insulin (Paek, Moise, Morgan, & Lysaght, 2005). Fujikawa et al., (2005) was successful in reversing Type 1 diabetes in mice using insulin-secreting cells derived from embryonic stem cells, however, the results lasted only three weeks due to tumor development secondary to the treatment.

Stem cell research in Parkinson's has yielded similar results. In 2006, Weiss et al. tested the therapeutic value of human umbilical cord stem cells from Wharton's jelly. These cells, called umbilical cord matrix stem cells, were transplanted into the brains of rats with Parkinson's, resulting in significant improvements in motion and behavior. In another research study, Brederlau et al., (2006) differentiated human embryonic stem cells into dopamine neurons in vitro for 16, 20, or 23 days, and then transplanted them into mice with Parkinson's. No alleviation of symptoms was found with any of the three groups, and the group that received the embryonic stem cells that were predifferentiated for only 16 days developed tumors.

In looking at the stem cells issue from the perspective of adult stem cells as equal or better alternatives than embryonic stem cells, the ethical issues shift from those of embryo destruction and cloning to those of resources and politics. Regardless of one's moral values in regard to embryo destruction or cloning, one may still face a dilemma when considering whether or not to endorse embryonic stem cells. For example, by voting for government funding of

embryonic stem cells research, one may unknowingly be propagating the use of tax dollars on research that is less promising than adult stem cells research. In the November 2006 Missouri elections, the pro- embryonic stem cells Amendment No. 2 won by a narrow 51.2% to 48.8% vote (Carnahan, 2006). The campaign's tag line, "It could save the life of someone you love," has been criticized for implying that cures from embryonic stem cells were imminent (Wagar, 2006).

Conclusion

In summary, the controversies regarding embryonic stem cells are issues in which pros and cons are weighed. It seems that the possibility that adult stem cells have more pros and fewer cons than embryonic stem cells has been overlooked amidst the embryonic stem cells debate. Compared to embryonic stem cells, adult stem cells also produce all three germ layers, but require no egg harvesting, cloning, or destruction of blastocysts, and are less tumorigenic. Adult stem cells research accounts for all clinical trials in humans and has shown more promise in key diseases.

One major flaw in the argument that adult stem cells are better than embryonic stem cells is that research on adult stem cells has been conducted for a much longer time than on embryonic stem cells. It is not fair to compare the advancements in each field when one field has had twice the amount of time to develop than the other. However, embryonic stem cells skeptics say that even if more time and funding was given to embryonic stem cells research than adult stem cells research, the public's high expectations of "miracle cures" would still be impossible to reach. I believe that with today's technological advancements, it would be foolish to say what will always be impossible. This is why I do believe in embryonic stem cells research. But I also believe in adult stem cells research just as much, and would think twice before voting on laws

that may allocate more money to embryonic stem cells research than adult stem cells research. Why pour time resources into a new field that is still in its infancy stages and is shrouded by legal and ethical controversy when a field that is on the brink of major breakthroughs already exists?

Healthcare providers should be informed on current healthcare issues in order to make informed decisions in the political realm. This is a professional responsibility of a nurse. And to become well informed on controversial issues, one must look at both sides with an eager, open mind. As stem cells continue to be one of the major issues in biomedical research, my knowledge will allow me to provide others with complete and accurate information on the topic.

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